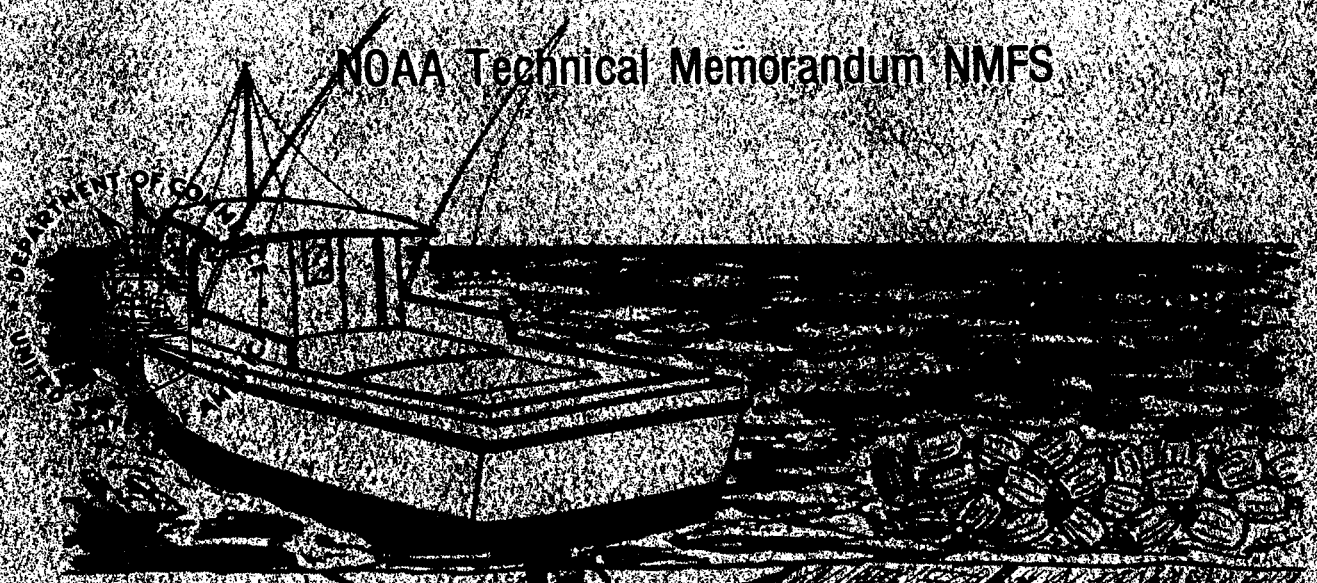
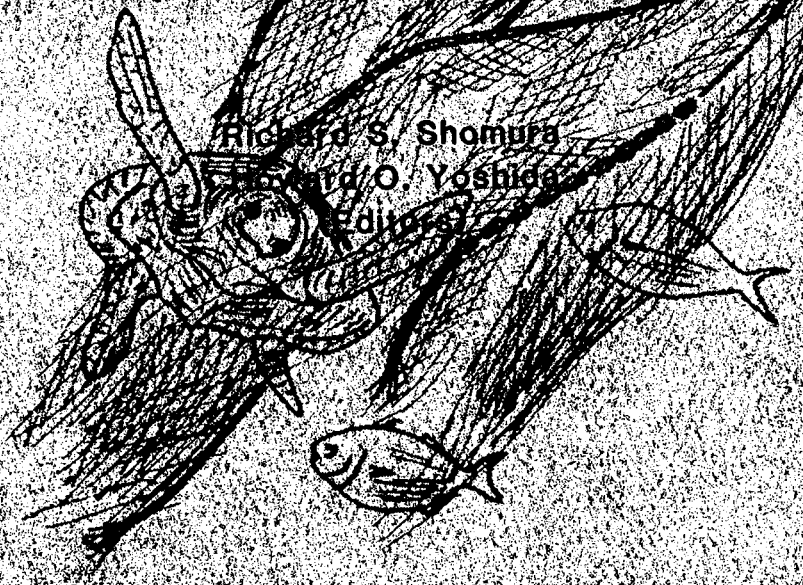
NOAA Technical Memorandum NMFS



PROCEEDINGS OF THE WORKSHOP ON THE FATE AND IMPACT OF MARINE DEBRIS

27-29 November 1984, Honolulu, Hawaii

Richard S. Shomura
Howard O. Yoshida
(Editors)



NOAA-TM-NMFS-SWFC-54

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Center

NOAA Technical Memorandum NMFS

The National Oceanic and Atmospheric Administration (NOAA), organized in 1970, has evolved into an agency which establishes national policies and manages and conserves our oceanic, coastal, and atmospheric resources. An organizational element within NOAA, the Office of Fisheries is responsible for fisheries policy and the direction of the National Marine Fisheries Service (NMFS).

In addition to its formal publications, the NMFS uses the NOAA Technical Memorandum series to issue informal scientific and technical publications when complete formal review and editorial processing are not appropriate or feasible. Documents within this series, however, reflect sound professional work and may be referenced in the formal scientific and technical literature.

NOAA Technical Memorandum NMFS

This TM series is used for documentation and timely communication of preliminary results, interim reports, or special purpose information; and have not received complete formal review, editorial control, or detailed editing.

JULY 1985

PROCEEDINGS OF THE WORKSHOP ON THE FATE AND IMPACT OF MARINE DEBRIS 27-29 November 1984, Honolulu, Hawaii

Richard S. Shomura and Howard O. Yoshida (Editors)
Southwest Fisheries Center, Honolulu Laboratory
National Marine Fisheries Service, NOAA
Honolulu, Hawaii 96812

Sponsors: Fish and Wildlife Service
Marine Mammal Commission
National Marine Fisheries Service
North Pacific Fishery Management Council
Pacific Fishery Management Council
Pacific Sea Grant College Programs
Western Pacific Fishery Management Council

NOAA-TM-NMFS-SWFC-54

U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary
National Oceanic and Atmospheric Administration
Anthony J. Calio, Deputy Administrator
National Marine Fisheries Service
William G. Gordon, Assistant Administrator for Fisheries

PREFACE

The events leading to the organization of the Workshop on the Fate and Impact of Marine Debris are described in the Executive Summary. In addition to the Executive Summary, the proceedings of the workshop contains an introduction, the full text of the papers presented at the three technical sessions, abstracts of oral presentations, an abstract of a poster session, and reports of the four Working Groups. All technical papers were reviewed by one or two referees. Although some papers report research in progress, the completeness of the records related to marine debris is enhanced by their inclusion.

In the Appendices are listed the steering group, the agenda of the workshop, a list of participants, a list of titles of background and working papers, and a bibliography on entanglement.

As Chairman of the Steering Group of the Workshop on the Fate and Impact of Marine Debris, the senior editor had the pleasure of working with individuals representing a wide spectrum of the scientific community: Officials of state and federal agencies, officials of the Marine Mammal Commission, Executive Directors of the North Pacific, Pacific and Western Pacific Fishery Management Councils, representatives of several conservation groups, and officials of fisheries agencies of the Governments of Japan, Republic of Korea, and Republic of China (Taiwan). The success of the workshop was ensured by the willingness of individuals to contribute and participate in the various sessions.

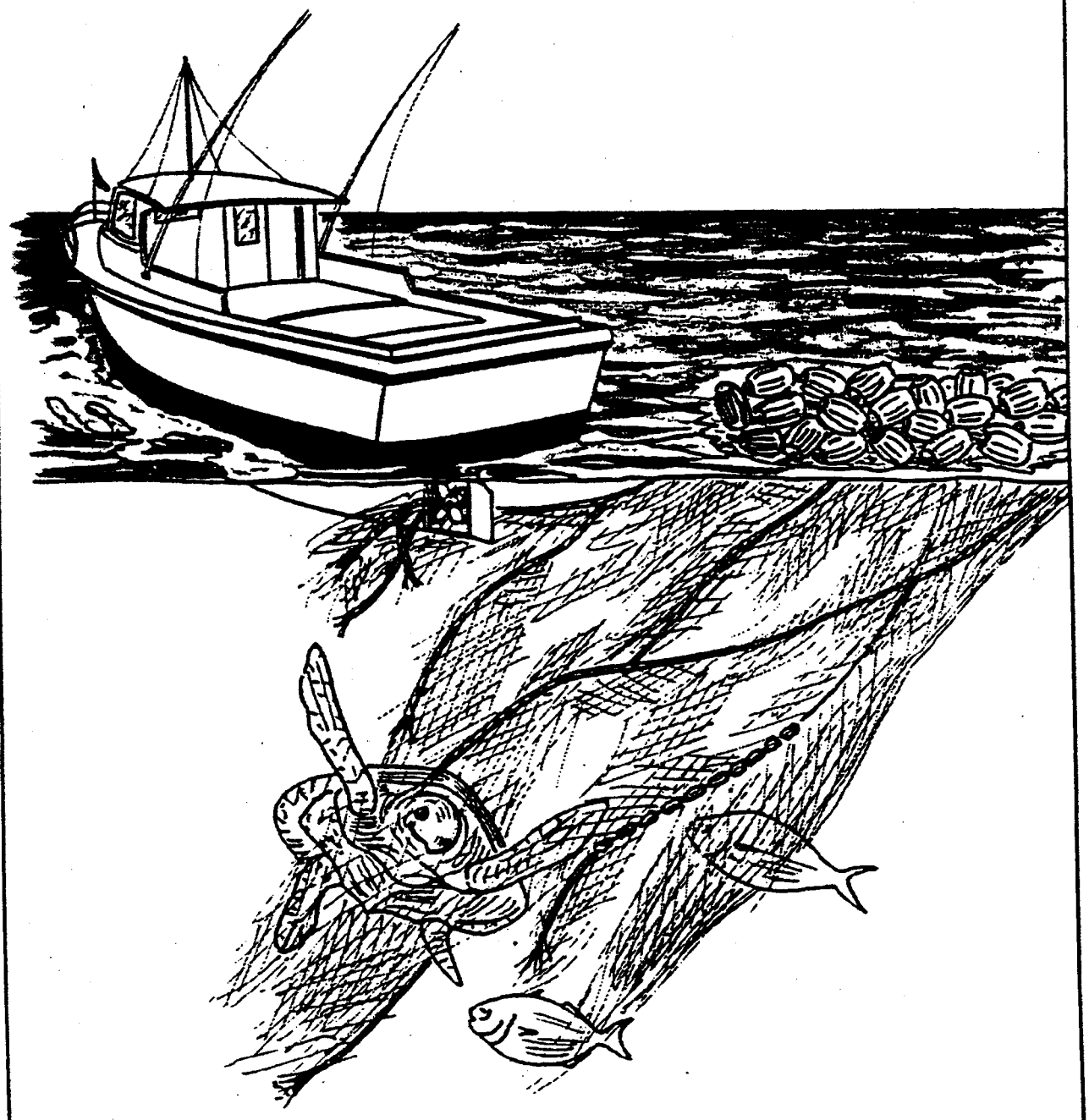
Suzanne Montgomery of Washington Communications Service, 150 N. Muhlenberg Street, Woodstock, Virginia, prepared the Executive Summary.

Special thanks are extended to the University of Hawaii Sea Grant College Program for their assistance in handling the logistics of the workshop and aiding in the preparation of the proceedings for publication.

Pacific Sea Grant College Programs contributing funds for the workshop included the University of Hawaii (NOAA Grant No. NA81AA-D-00070), the University of Alaska (NOAA Grant No. NA82AA-D-00044C), the University of California (NOAA Grant No. NA80AA-D-00120), and the University of Washington (NOAA Grant No. NA84AA-D-00011). This proceedings is also a Hawaii Sea Grant College Program cooperative report, UNIHI-SEAGRANT-CR-85-04.

TABLE OF CONTENTS

EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

I. INTRODUCTION

For the past decade, concern has been growing among scientists, fishermen, conservationists, and others over the markedly increased volume of marine debris apparent in the world's oceans. This form of marine pollution may be a particularly serious problem in the North Pacific Ocean, where an abundance of lost or discarded fishing gear and other nonfisheries-generated material, including cargo nets and plastic packing bands, may be contributing to the mortality of several marine species. These include marine mammals, notably northern fur seals and Hawaiian monk seals, marine turtles, seabirds, and fishes--organisms which may become entangled with or ingest man-made debris. This debris may also pose a potential threat to human safety as a result of fouling vessel propulsion systems.

Many of those concerned have pointed out the need for a more precise definition of the problem. In 1982 the Marine Mammal Commission asked the National Marine Fisheries Service (NMFS) to organize a workshop to address the marine debris issue and provided initial planning funds for that purpose. In December 1983 the Southwest Fisheries Center Honolulu Laboratory, NMFS, established a Steering Group to organize an international workshop to address the scientific and technical aspects of the marine debris problem and its impact on marine resources. The Workshop on the Fate and Impact of Marine Debris took place 26-29 November 1984 at the Ala Moana Americana Hotel in Honolulu, Hawaii.

Objectives.--The objectives of the Workshop, as defined by the Steering Group were to: (1) review the state of knowledge on the fate and impact of marine debris to determine the extent of the problem; (2) identify and make recommendations on possible mitigating actions; and (3) identify and make recommendations on future research needs. The Steering Group recognized that active fishing operations, such as the high seas gill net fisheries in the North Pacific, may also pose a serious threat to marine species, but determined that this problem was beyond the scope of the planned Workshop. Thus, the Honolulu Workshop was limited to consideration of marine debris and its impact on marine species.

Workshop Organization.--To lay the groundwork for subsequent discussion, the Workshop was opened with a review of the existing conventions, laws, and regulations that could provide a legal framework for dealing with the problem of marine debris. Background and experience papers on three aspects of the problem were presented in the technical sessions that followed. The session topics were: the source and quantification of marine debris; the impact of debris on marine resources; and the fate of marine debris in the world's oceans. Because of the broad public interest in the topic, particularly as regards the entanglement issue, a fourth, general session was held to focus on identification of management needs.

Upon completion of the technical sessions, participants met in four separate Working Groups to discuss the results of the technical sessions and to formulate recommendations on needed actions. At a final plenary

session, Working Group chairmen summarized the results of these deliberations for consideration by the Workshop participants as a whole.

Sponsors and Participants.--Sponsors of the Workshop included: the U.S. Fish and Wildlife Service, the Marine Mammal Commission, the NMFS, the North Pacific Fishery Management Council, the Pacific Fishery Management Council, the Pacific Sea Grant College Programs, and the Western Pacific Regional Fishery Management Council.

Participants included representatives of these groups along with scientists from various disciplines, administrative and management personnel from Federal and State offices, and representatives of the fishing industry, the academic community, conservation groups, and aquaria. Although participants were primarily from the United States, scientists from the Republic of Korea, Japan, the Republic of China (Taiwan), New Zealand, Canada, the Federal Republic of Germany, and the United Kingdom were also present.

II. BACKGROUND

The tendency of marine mammals and other marine species to become entangled in pieces of fishing or cargo nets, packing bands, and other debris lost or discarded at sea has been recognized for many years. In the mid-1960's, the North Pacific Fur Seal Commission noted the increasing number of northern fur seals in the harvest that were becoming entangled in material lost or discarded by fishermen and the merchant fleet. Over the past decade, the four nations party to this convention--Canada, Japan, the United States, and the Soviet Union--have attempted to check this problem through an educational program directed at the fishing operations in the North Pacific Ocean.

Over this same period, it has become apparent that the problems of entanglement are not limited to northern fur seals, but also involved other marine mammals species, including the endangered Hawaiian monk seal, sea lions, harbor seals, and northern elephant seals. Other incidents involving entanglement of seabirds, marine turtles, and fish have also been recorded.

Simultaneously, it has been found that some species, including endangered species of sea turtles and many species of marine birds, are ingesting ocean debris, such as plastic bags, small plastic pellets (believed to be the raw form of material used in molding plastic products), and other man-made materials.

While many of the incidents of entanglement and ingestion of marine debris have been observed in the North Pacific Basin, data from other areas of the world show that the problem is global.

In most instances, the extent of entanglement in and ingestion of materials by marine species is not known; nor is it clear what impact this interaction between marine animals and man-made debris may be having on individual animals or populations as a whole. There is reason to believe, however, that entanglement of northern fur seals in net fragments, lines, packing bands, and other debris may be a significant mortality factor.

Based on data analysis carried out in preparation for the April 1982 meeting of the North Pacific Fur Seal Commission, a preliminary estimate of the annual mortality rate due to entanglement at that time was that it was more than 5% of the population as a whole. Subsequent analyses indicate that mortality from entanglement may exceed the original estimate and probably has its greatest effect on young animals.

There are also questions about the sources of such debris and what ultimately happens to it once it enters the marine system. However, it is increasingly apparent that marine mammals, seabirds, turtles, and fish are becoming entangled in or are ingesting man-made debris lost or discarded in the oceans.

III. SUMMARY OF TECHNICAL SESSIONS

The Workshop program included 29 invited background and working papers presented during 3 technical sessions. The technical sessions focused on: Source and quantification of marine debris, chaired by Dayton L. Alverson; impacts of debris on resources, chaired by Douglas G. Chapman; and fate of marine debris, chaired by James D. Schumacher. A summary of the technical sessions follows.

Session I. Source and Quantification of Marine Debris

The purposes of this session were to describe sources of marine debris and, to the extent possible, indicate the quantity that may exist in the North Pacific Ocean. The widespread occurrence of debris was well documented by various papers presented during all three technical sessions of the Workshop. However, it was clear that accurate estimates of the volume of debris both entering and leaving the North Pacific Ocean annually are lacking.

The nature and magnitude of the major fisheries in the North Pacific that could be contributing significantly to marine debris were described by several participants. The high seas gill net fisheries offer a substantial potential for generating debris due to the large quantity of gear used. Uchida reported that 170,000 km of gill nets are used by 15 fisheries annually. The Japanese coastal sardine and herring fisheries represent 72% of this activity. The trend in use of high seas gill nets is not clear, but it appears the reduction in Japanese high seas effort since 1958 (Fredin) is compensated for by the increased Taiwanese squid effort since 1970 (Chen).

The trawl fishery is the other major activity in the North Pacific Ocean with a potential for generating netting debris. While not as large as the high seas gill net fishery in terms of miles of netting in the water, the trawl fishery is a significant effort in the area. Since about 1962, the total trawling effort by all countries has been relatively stable at between 2,000 and 2,500 vessel months per year (Low et al.). This view was generally corroborated by Fredin.

Another significant source of debris was suggested in the presentation by Neilson. Both from land-based and water-related activities, the general population contributes a variety of debris in the form of polystyrene,

strapping bands, rope, packaging materials of many types, plastic bags and sheets, and plastic food utensils.

The quantity of debris in the North Pacific was addressed by four papers covering various aspects and geographic areas. Merrell and Neilson described types and quantities of debris found on beaches in Oregon, southwest Alaska, and Amchitka Island in the Aleutians. Merrell reported that trawl netting constituted 67 to 85% of the debris by weight on the beaches studied in Alaska. Neilson reported that a synoptic survey of Oregon beaches yielded 26 tons of material in about 3 h. It was primarily polystyrene, plastic food utensils, bags or sheets of plastic, and plastic bottles. Fishing materials represented a relatively small part of the total.

Dahlberg and Jones reported results of debris observations on the open ocean. From a survey between Hawaii and Kodiak, Alaska, Dahlberg noted geographic areas of concentration, due presumably to the action of ocean currents. The types of material were similar to those reported by Neilson in Oregon. Both Dahlberg and Jones noted that the amount of debris sighted was low, but a paper by Lenarz indicates that the observed densities are not inconsistent with mortality rates estimated for northern fur seals.

Session II. Impact of Debris on Resources

The aim of this session was to present the results of observations of marine debris impacting marine organisms or man, largely at the individual level. A review of the literature by Wallace included some unpublished results of research on debris entanglement and debris ingestion. Also noted were some impacts on humans, including entanglement during underwater activities and in vessel propellers.

Incidences of entanglement have been monitored most extensively for northern fur seals, primarily as part of the subadult male harvest. Since the late 1960's, a record of such observed entanglement has been made for St. Paul Island in the Pribilofs. More intensive studies have been made in recent years. The results, while suggestive, provided only an indirect explanation of the recently observed decline (about 6.5% per year) in fur seal populations in the Pribilof Islands. As part of this work, Fowler developed models which indirectly related the population decline to entanglement, but more recently and more directly, in a paper presented in this session, showed correlations between observed entanglement on land and changes in the number of pups born.

Since Steller sea lions feed also in an area used by fur seals, it is not surprising that these animals are also observed entangled in netting and plastic packing bands. Calkins reported on such incidents and also on beach surveys that attempted to determine the proportion of marine debris on beaches that has potential for entangling animals. Similar observations were reported on by Stewart and Yochem with respect to several species of pinnipeds in the Southern California Bight. In general, rates of entanglement in this area were much lower than for the northern species discussed above.

There are scattered incidences of monk seal entanglement, some in published reports but many in unpublished reports and field notes. Such reports have been collected and were summarized for the years 1976 to 1984 in a paper presented by Henderson.

Three papers reported on entanglement or ingestion of marine litter, primarily plastic bags and pellets. One reported on such incidents in New Zealand, one on marine birds around the world, and one on marine turtles. While the fact of such plastic ingestion is clear, the actual impact on the individual animals is much less clear.

In separate papers, High and Carr reported on directed and incidental observations of various types of lost gear, e.g., crab pots, longline, and gill nets, that have continued to "fish" for periods of several years after becoming derelict. These studies demonstrate that such "ghost" gear will have continuing impact on the resources being targeted by the fishery, but until more is known on the amount and longevity of such lost gear, it is not possible to quantify the impact at the population level.

Session III. Fate of Marine Debris

The goal of this session was to review the state of knowledge on the fate of marine debris in the North Pacific Ocean, including the Bering Sea. Two papers were presented on forcing mechanisms for and behavior of the general circulation, followed by two presentations that viewed the question of fate of marine debris from model perspectives.

From presentations by Seckel and Reed, it is evident that our understanding and description of general circulation have advanced significantly, due particularly to the wealth of direct current measurements made during the past decade. The lack of knowledge of debris behavior with time and the natural variability of the upper ocean, however, preclude prediction of debris transport on an individual item basis. Concentrations of debris, however, were suggested to be most likely in either the Subarctic Convergence Zone or on the west coast of North America from about lat. 40° to 50°N.

Presentations by Galt and Gerrodette focused on model approaches to the problem of debris. Galt indicated processes whereby debris would most likely be concentrated and regions where such processes are active. The Subarctic Convergence was again noted as a region of reduced spreading tendency. Observations presented by Dahlberg indicated higher concentrations of debris actually existed here. Gerrodette presented a conceptual model, based on population dynamics, which considered marine debris as a group of various species whose birth and death rates are poorly quantified. Critical for this approach is information on how much debris exists and where and when it entered the marine environment. This model was a useful framework for Working Group III discussions about possible mitigating actions and for identification of needs for future research.

IV. SUMMARY OF WORKING GROUP MEETINGS

The reports of the four Working Groups reflect the perspectives from which each approached the issue of marine debris in the world's oceans--its origins, its impact on marine species, its fate in the marine environment,

and tools for addressing and managing the problem. Full reports of the three technical Working Groups and the Working Group on Management Needs are included in the proceedings of the Workshop. The Working Group reports are summarized here.

As became apparent during the final plenary session of the Workshop, a number of common conclusions and similar recommendations emerged from the individual Working Groups. For example, the groups agreed on the need for: extensive efforts to educate the public on the marine debris problem; quantitative data to assess the impact of debris on marine resources; and increased information to determine the sources and distribution of debris.

Working Group participants agreed that despite insufficient data, available evidence shows that marine debris now threatens a number of marine species, including marine mammals, seabirds, marine turtles, and fish, and presents a hazard to vessel operations. Clearly, the problem is not limited to any group or groups of animals, but can affect commercially valuable species and endangered and threatened species, as well as human safety at sea.

At the same time, the groups recognized that marine debris may have positive benefits for both marine species and man, such as a tendency to concentrate finfish, which should be investigated.

It was also recognized that entanglement of nontarget marine animals in actively fishing gear may pose as great or a greater problem than interactions with marine debris, and it was agreed that this issue should be addressed in another forum.

While the precise impacts on marine populations as a whole are not known, the Working Groups agreed that it was clear that marine debris negatively affects certain marine species on an individual level. These include the northern fur seal, which is experiencing a population decline, and the endangered Hawaiian monk seal. Marine debris also impacts other species, including certain seabirds, turtles, and fish resources. Thus, the Working Groups placed major emphasis on the need for studies to assess the impact of marine debris on marine resources. Such studies should be undertaken in concert with efforts to educate user groups and the public on the marine debris problem and to obtain additional information on its source and extent.

From the common threads woven throughout the four Working Group reports, it was clear that education may be the most effective first step in addressing the marine debris problem. Information programs explaining the problem should be developed for user and interest groups, including the fishing industry, the plastics manufacturing industry, the public, merchant carriers, the military, and appropriate international groups. Such efforts could lead to a reduction in the discard of material from both shipboard and land-based sources and could spur development of relatively simple techniques to reduce the impact of such debris.

The Working Groups recommended that programs be implemented to apprise involved industries and the public of the extent and impacts of marine debris and the means by which these problems might be mitigated. For

example, the fishing industry should be advised that wanton discard of unwanted gear and net fragments may endanger not only marine mammals, birds, and turtles, but can impact fish resources through "ghost-fishing" (the tendency of some discarded fishing gear to continue to take fish) and imperil their vessels by fouling propulsion systems.

To mitigate debris problems, crews of merchant vessels should be informed that a step as simple as cutting plastic cargo bands before discarding could eliminate entanglement of marine animals. The plastics manufacturing industry should be advised that disposal of plastic pellets in their factory effluents is jeopardizing certain species of marine birds and turtles. Manufacturers of fishing nets and other gear should be advised of simple measures that could reduce the potential adverse effects of such material on marine species. For example, plastic packing bands could be stamped with instructions that they be cut before they are discarded.

The Working Groups also agreed that the general public should be made aware of the marine debris problem and its help solicited in increasing efforts to clean up beaches and areas where debris may concentrate.

At the same time, the Working Groups agreed that a mechanism is needed to improve the exchange of ideas, data, and techniques on the marine debris problem. It was specifically recommended by one group that the NMFS designate a person of appropriate stature as program coordinator for the marine debris problem. The Working Groups concluded that exchange of such information would be facilitated through a more precise definition of common terms and the assembly of a catalog or reference collection to aid in identification of net fragments and other forms of commonly found debris.

International cooperation was considered essential in addressing the marine debris issue. Working Group I identified possible sources of additional information and expertise that might contribute to an increased understanding of the problem. These sources include the International North Pacific Fisheries Commission data on net design and usage in the northeast Pacific region; available data on U.S. fishing activities in the eastern portion of the North Pacific; and historical observations of entanglement, particularly involving northern fur seals.

The Working Groups also agreed on the need to obtain more information from foreign fisheries operating in the U.S. Exclusive Economic Zone and from fishing activities elsewhere in the world, both to pinpoint origins of marine debris and to determine the extent of the problem. For example, it was recommended that information on fouling of fishing and recreation vessels, as well as other waterborne traffic, should be collected in order to assess the full scope of impacts on marine debris.

Workshop participants identified several steps that could be taken to help determine the origin of marine debris, such as a requirement that all fishing nets be marked for identification, both to determine the origin of the derelict net and the area where it was lost. It was suggested that ocean-going vessels be used as "platforms of opportunity" to help assess the quantity and distribution of debris and that fishing and merchant vessels should be asked to contribute data on rate and location of gear loss so that the fate of such debris could be determined.

The Working Groups also recommended that efforts be initiated to investigate means of regulating sizes and types of mesh used in those sections of nets likely to be lost or replaced at sea. It was proposed that fishermen be required to install biodegradable (e.g., vegetable fiber) material in critical portions of nets and on fishing pots. Accidental loss of nets might be reduced through development of charts to identify areas where snags are known to exist.

It was also considered important to conduct experiments to study the fate of lost fishing nets, including where the nets go, how they are broken down by natural forces, and how long they may pose a hazard to marine life and humans.

Workshop participants noted that, while several species and types of marine animals are impacted by marine debris, it is not possible to make generalizations about the problem. Available information suggests that the northern fur seal is the species most seriously affected by marine debris, but because of limited data, precise estimates of entanglement-caused mortality rates have not been produced. Additional research is needed to gain a better understanding of the effects of debris on northern fur seal population dynamics. At the same time, it will be necessary to address other potential causes of the ongoing decline in the northern fur seal population.

It was concluded that further information is needed to confirm the level of northern fur seal mortality resulting from entanglement; to determine if northern fur seals become entangled in netting of all sizes in proportion to its frequency; to compare the distribution of netting at sea and on beaches; and to measure the drag effect on seals entangled in debris and the impact on the animals' ability to forage. Five specific research projects were recommended to obtain information in these areas: radio-tagging experiments to track entangled seals; placement of marked debris near rookery islands to determine its fate; additional beach surveys to document quantity and types of debris; sampling programs to determine distribution of debris at sea; and comparison on impacts on northern fur seals with those on other pinnipeds.

Workshop discussions suggested that the marine debris problem today may parallel the pesticide problem as it emerged in the 1960's. Just as raptors were the early indicators of widespread pollution by pesticides, northern fur seals may represent the "tip of the iceberg" as regards marine debris. That is, marine debris may be a generic and widespread problem, and investigations of its impact on other species may indicate similar patterns and effects. It was felt that, if additional research on northern fur seals leads to a recognition of a widespread problem, scientists and managers would be in a better position to manage marine resources in general.

V. CONCLUSIONS AND RECOMMENDATIONS

The Workshop considered the information presented during the technical sessions and concluded that there is ample evidence that debris of both terrestrial and shipborne origin are widespread in the marine environment. While such debris is known to interact with a wide variety of marine

mammals, fishes, turtles, birds, and invertebrates, in most instances the consequences and quantitative impacts of this interaction do not appear to be well understood. However, substantial qualitative evidence indicates these interactions are contributing to increased mortality over that resulting from natural causes.

As a means of addressing the uncertainties surrounding this problem while mitigating the known impacts, the Workshop agreed to the following recommendations:

Education.--Efforts should be undertaken to advise user and interest groups of the nature and scope of the marine debris problem. Such groups should include the fishing and plastics manufacturing industries, merchant carriers, the military, appropriate international groups, and the public.

Collection of information.--Studies should be undertaken to:

* Assess the impact of marine debris on marine resources, including fish species, northern fur seals, Hawaiian monk seals, seabirds, and marine turtles.

* Determine the sources and distribution of debris, possibly through development of a sampling methodology.

* Determine the fate of lost gear and debris once it is deposited in the marine environment.

* Develop a means of identifying derelict gear through creation of a reference collection.

* Obtain worldwide data on vessel disablement as a result of interactions with marine debris.

Additional efforts should be undertaken to: Develop alternative methods for both fishing and nonfishing activities to replace those methods that contribute significantly to the marine debris problem; identify and publicize geographic areas where fishing gear is likely to be snagged and lost; determine the impact of debris on the seafloor; obtain data on gear loss of high seas gill net fisheries; establish the severity of the debris problem in areas other than the North Pacific; examine possible positive benefits of debris; determine impacts of ingestion of debris by seabirds and turtles and other marine organisms; and expand existing stranding networks for marine mammals, birds, and turtles, and incorporate examinations for evidence of interactions with debris.

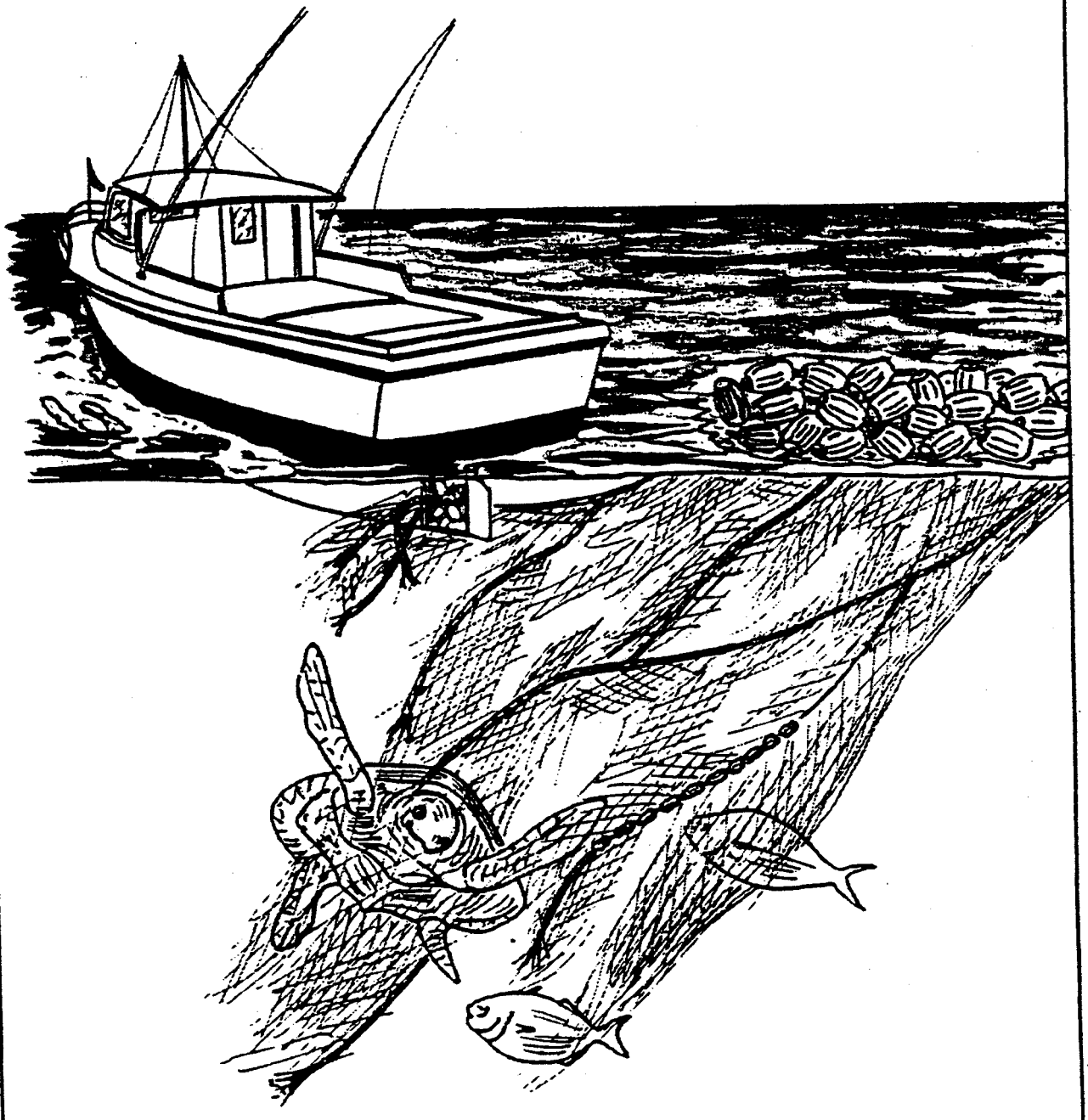
Mitigation.--Two major efforts are recommended:

* Regulate disposal of material that can result in high negative impact on resources; and

* Investigate use of biodegradable materials in gear construction and the recycling of net materials.

Additionally, it is recommended that efforts be made to regulate use of gear that has a major impact on resources and to encourage surveys and clean up of beaches where interactions between marine species and debris is likely to occur.

INTRODUCTION



LEGAL AUTHORITIES PERTINENT TO ENTANGLEMENT BY MARINE DEBRIS

Michael Gosliner
Office of General Counsel, NOAA
Washington, D.C. 20230

ABSTRACT

A variety of statutes and treaties are potentially applicable to marine debris, although no law specifically addresses this problem. These laws may be separated into four categories: pollution control laws such as the London Dumping Convention or the Ocean Dumping Act, wildlife laws such as the Endangered Species Act or the Marine Mammal Protection Act, fisheries laws such as the Magnuson Fishery Conservation and Management Act, and pollution abatement laws such as the Superfund Legislation. All of these authorities are analyzed and the enforcement difficulties are considered. Alternative enforcement mechanisms are examined, including gear marking, a bounty system on discarded fishing gear, and an expanded observer program. Where possible, the statutes are examined to determine what types of research would be most useful in filling the information gaps which inhibit effective utilization or enforcement.

ISSUE

The Marine Mammal Commission (Commission), in a letter dated 18 November 1983, requested that the National Oceanic and Atmospheric Administration (NOAA) identify and evaluate all domestic and international authorities which may be useful in preventing the dumping of fishing gear and other debris which may be responsible for the entanglement of marine mammals. The Commission further requested that any authority be identified which might be used to facilitate the recovery of gear fragments and other discarded material already in the sea. In making its request, the Commission voiced its concern for the seriousness of the entanglement problem, particularly with respect to the North Pacific fur seal and the Hawaiian monk seal.

SUMMARY AND CONCLUSION

Although the extent of the entanglement problem is unknown, it has been hypothesized that the numbers of fish, marine mammals, and seabirds killed or injured by discarded fishing gear and other debris are substantial. Several pollution control statutes and treaties which prohibit or limit the dumping of debris into the oceans may be useful in curbing the

---

In R. S. Shomura and H. O. Yoshida (editors), Proceedings of the Workshop on the Fate and Impact of Marine Debris, 26-29 November 1984, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-54. 1985.

disposal of net fragments and other material. Wildlife statues currently prohibit the unpermitted taking of numerous species and may be useful in reducing the entanglement of birds, fish, marine mammals, and sea turtles.

The Magnuson Fishery Conservation and Management Act (Magnuson Act), which regulates fishing within 200 miles of the United States, may also be used to prohibit the disposal of fishing gear at sea and the entanglement of wildlife. However, for any of these laws to be enforceable the originator of the debris must be identified. Since the disposal of debris generally occurs in remote locations, identification of violators is usually difficult. Alternative methods of enforcement, including more extensive marking of gear, the institution of a bounty on net fragments, or the expansion of the observer network should be investigated.

Even if no additional fishing debris is ever lost or disposed of, that currently in the oceans may continue to present a hazard to fish, wildlife, and navigation. Fishing nets are highly persistent and may remain suspended in the water column indefinitely. Provisions of the Federal Water Pollution Control Act and the Comprehensive Environmental Response, Compensation, and Liability Act arguably provide authority for the clean up of debris within the 200-mile, U.S exclusive economic zone (EEZ).

BACKGROUND

Recently a marked decline in the fur seal populations of the Pribilof and other North Pacific islands has been observed. In 1980, the species population was estimated to be 1.74 million seals. Current estimates place the population at about 1.2 million seals (North Pacific Fur Seal Commission 1984). The decline estimates for the Pribilof Island population is between 5 and 8% per year.

Although it is known that fur seals do become entangled in fishing gear and other debris, mortality rates of entangled seals are unknown. However, it is likely that many of the seals which become entangled in discarded fishing gear or other debris cannot free themselves and ultimately die from strangulation, starvation, or infection. Fowler (1982) has hypothesized that 5% or more of the fur seal population may die annually from entanglement and that this mortality may be a primary cause of the observed decline in fur seal numbers.

In addition to seals, other marine mammals, including whales, may be prone to entanglement. Sea turtles have also been cited as potential entanglement victims. The mortality of seabirds due to entanglement in fishing gear has been estimated to be several hundred thousand per year.

Lost or discarded fishing gear also continues to capture fish as it drifts at sea. This untended activity is referred to as ghost fishing and affects commercial and unexploited species of fishes as well as marine mammals, birds, and turtles. Concern has also been expressed that drifting gear poses a safety threat to vessels. Some entanglement of vessel propulsion systems has been reported.

DISCUSSION

Statutes and Treaties

Most statutes and treaties that are pertinent to the problem of the disposal of fishing gear at sea and the resultant entanglement take one of two tacks. The London Dumping Convention (Convention), the MARPOL Protocol, the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA), the Federal Water Pollution Control Act (FWPCA), and the Resources Conservation and Recovery Act of 1976 (RCRA) seek to prevent the disposal of harmful substances in the oceans. Wildlife statutes, such as the Marine Mammal Protection Act (MMPA), the Fur Seal Act, the Endangered Species Act (ESA), and the Migratory Bird Treat Act (MBTA) generally prohibit, with certain exceptions, the capturing or killing of species subject to their provisions. This second category of laws does not prevent the discard of debris, except as may be specifically prohibited by regulation if a take is reasonably certain to result. Rather, it imposes sanctions only after a protected animal is actually ensnared.

A third type of statute, which contains components of each of those previously mentioned, is the Magnuson Act. This statute requires the conservation and management of United States fisheries. Regulations issued pursuant to the Magnuson Act specify when and how fish may be taken. Regulations currently prohibit foreign fishing interests from intentionally discarding fishing gear.

Lastly, there are laws which provide mechanisms to abate existing pollution problems. Provisions of the FWPCA and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) authorize the clean up of certain substances. These statutes and treaties are discussed individually and in detail below.

Pollution Control Laws

Pollution control laws regulate what substances may legally be released into the oceans and specify the circumstances under which those releases may be made. The Federal statutes which address ocean dumping are administered primarily by the Enviromental Protection Agency (EPA). The focus of much of EPA's authority is the control of hazardous substances, particularly toxic chemicals. Therefore, EPA regulations are often designed to address those materials rather than the persistent objects which may be responsible for entanglements. If the various definitions of hazardous substances contained in pollution control statutes can be construed to include discarded fishing gear, clean up authority may exist. Statutes which authorize the clean up of hazardous wastes are discussed in a later section.

Convention on the prevention of marine pollution by dumping of wastes and other matter (London Dumping Convention), 26 U.S.T. §2403.--The Convention to which the United States is a party, prohibits the dumping of certain wastes or other matter at sea. "Dumping" under the Convention includes "any deliberate disposal at sea of wastes or other matter from vessels..." but does not include "the disposal at sea of wastes or other matter incidental to, or derived from, the normal operations of vessels..."

unless the vessel is operating for the purpose of disposing or treating such matter (Art. III, §1). Under this definition, some of the debris responsible for entanglements may be covered by the Convention, but other debris may not be.

Clearly, debris that is generated on land and taken to sea for the express purpose of dumping is within the coverage of the Convention. However, dumping, for the purposes of the Convention, only includes deliberate disposal. Any accidental loss of debris is not governed. More important in the context of entanglements is the exception for the disposal of matter incidental to the normal operation of vessels. Net discards which are generated in the course of fishing operations may be considered to fit that exception. The countervailing argument to this interpretation is that while the generation of net fragments may be incidental to fishing operations, the intentional disposal of this debris does not constitute the normal operation of a fishing vessel.

The Convention requires the issuance of a permit before most materials can be dumped, but prohibits, except in emergency situations, the dumping of wastes or other matter listed in Annex I to the Convention. Included in Annex I are "persistent plastics and other persistent synthetic materials, for example, netting and ropes, which may float or remain in suspension in the sea in such a manner as to interfere materially with fishing, navigation or other legitimate uses of the sea" (Annex I, §4).

Generally, the types of materials involved in entanglements are included in Annex I. If one assumes that the disposal of this debris constitutes dumping under the Convention's definition, the applicability of the Convention hinges upon how one defines the phrase "legitimate uses of the sea." A strong argument can be made that the utilization of the oceans to ensure healthy populations of marine mammals and other marine fauna is a legitimate use of the sea which is materially interfered with when casting off netting and other debris.

As discussed below, the MPRSA, which implements the Convention, when strictly construed, may not prohibit the domestic dumping of refuse, but may merely prohibit transport for the purpose of dumping. Nevertheless, regulations issued pursuant to the MPRSA seem to implement the strictures of the Convention.

Applicability of the Convention to the disposal of fishing gear may prove helpful in alleviating the entanglement problem. Japan ratified the treaty in 1980, joining other sizable fishing nations such as the U.S.S.R., People's Republic of China, the United States, Canada, and Poland as contracting parties. Among the principal exploiters of the North Pacific fisheries only the Republic of Korea has not joined the Convention. Even though the Convention addresses the problem on an international scale, it is not a panacea. Since the generation of a significant portion of the entangling debris takes place at sea, enforcement is difficult, if not impossible. It is not known precisely how other party nations have implemented the Convention domestically. A research effort is being undertaken to ascertain the specific foreign laws that may be applicable to the entanglement problem.

Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL Protocol).--The MARPOL Protocol seeks to counter most forms of pollution generated by ships, including that from oil, toxic substances, sewage, and garbage. The MARPOL Protocol, unlike the Convention, covers the accidental disposal of matter incidental to normal vessel operations. One important exception to the applicability of the MARPOL Protocol, however, is provided by its definition of "discharge." This term does not include "dumping within the meaning of the [Convention]." Therefore, if it is determined that a category of debris falls within the parameters of the Convention, its discard is not governed by the MARPOL Protocol.

Annex V to the MARPOL Protocol, one of three optional annexes and not yet in force, regulates the disposal of garbage at sea from ships. In general, the disposal of "all plastics, including but not limited to synthetic ropes, synthetic fishing nets, and plastic garbage bags is prohibited." An exception is made though, for the "the accidental loss of synthetic fishing nets or synthetic material incidental to the repair of such nets, provided that all reasonable precautions have been taken to prevent such loss." Although these accidental losses of nets are exempted from the general prohibitions of Annex V, its applicability to much of the debris that is responsible for entanglements is clearer than that of the Convention.

Entered into force in October 1983, the MARPOL Protocol consists of far fewer parties than the Convention. Of the major North Pacific fishing nations, Japan, People's Republic of China, the U.S.S.R., and the United States have ratified or acceded to the MARPOL Protocol. Japan is the only one of these nations to adopt the optional annexes (including Annex V), but acceded to the MARPOL Protocol with a reservation. The optional annexes are not now in force. They shall enter into force only after they have been adopted by at least 15 nations whose fleets jointly constitute 50% of the gross tonnage of the world's shipping.

As with similar attempts to prohibit the dumping of inert substances in the oceans, the MARPOL Protocol would be virtually unenforceable. To be covered, not only would net fragments have to be identifiable to a particular vessel, but it would have to show that the loss of the gear was not accidental or that reasonable precautions to prevent the loss were not taken.

The Act to Prevent Pollution from Ships (Act) (33 U.S.C. §1901), domestically implements the MARPOL Protocol. Under the Act it is a violation for any vessel, while in the navigable waters of the United States, and for a United States vessel anywhere, to act in violation of the MARPOL Protocol or regulations issued pursuant to the Act (33 U.S.C. §1907). Since the United States has not yet adopted optional Annex V, its prohibitions are not included in the Act.

Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA) (33 U.S.C. §1401).--The MPRSA, which implements the Convention, primarily addresses ocean dumping by regulating the domestic transportation of wastes or other debris for the purposes of dumping and by prohibiting the act of dumping within the U.S. territorial sea and contiguous zone (out to 12

miles) if the material has been transported from outside the United States. The usefulness of this statute to address entanglement problems resulting from foreign fishing is limited, however, since most foreign fishing operations occur beyond the contiguous zone.

The MPRSA provides that except in those instances in which a permit has been issued, no person shall transport from the United States, and no vessel registered in the United States shall transport from any location, any material for the purpose of dumping it into ocean waters (33 U.S.C. §1411(a)). In taking this tack, the U.S. Congress failed to prohibit explicitly the dumping of debris but clearly prohibited transportation for this purpose. Net fragments are, in general, not purposefully transported for disposal. The intent to dispose of fishing gear usually does not develop until it breaks at sea, after it has already been transported. Thus, the MPRSA appears, on its face, to be inapplicable to gear discarded from domestic fishing vessels or to debris from other vessel classes.

The legislative history, however, expresses a congressional intent to prohibit the actual dumping of debris, not merely its transportation for the purpose of dumping. The purpose of the legislation, as explained in the Senate report accompanying the 1972 MPRSA, was to ban "the transportation for dumping and dumping beyond the territorial jurisdiction of the United States of...waste material unless authorized by a permit" (emphasis added) (S. Rept. 451, 92d Cong., 2d Sess., reprinted in [1972] U.S. Code Cong. & Ad. News 4234, 4234). Elsewhere in the U.S. Senate report, however, the purpose of the Act was declared "to be the regulation of the transportation of material for dumping into the oceans..." (Id. at 4243).

The seeming inconsistency among the statutory language and the two expressions of legislative intent is clarified in the section by section analysis of the Senate report. That analysis provides that the prohibition of certain actions under the Act "on the jurisdictional basis of regulating transportation is an appropriate assertion of sovereignty of the United States without breaching the inherent issues of international maritime law" (Id. at 4245). Although the high seas are open to all nations and no nation may validly subject any part of them to their sovereignty, the right to regulate commerce proceeding from the ports of a country including that engaged in by foreign vessels, is well recognized in international law. Thus, Congress concluded that "[a]sserting jurisdiction to regulate transportation by persons subject to the jurisdiction of the United States for the purpose of dumping in the oceans (whether they be high seas or not) attains the same objective as a direct prohibition of dumping without doing violence to principles of international law" (Id. at 4246).

That Congress intended to prohibit the dumping of material as well as transportation for the purpose of dumping is also enunciated in the legislative history of the 1974 amendments to the MPRSA. The Senate report set out the purpose of the amendments: "to make [the MPRSA] fully consonant with the treaty responsibilities of the United States under the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter" (S. Rept. 726, 93d Cong., 2d Sess., reprinted in U.S. Code Cong. & Ad. News 2792, 2792). This treaty, discussed in greater detail above, requires its signatories to prohibit the "dumping" of certain, designated materials, including synthetic nets and ropes, not merely the transportation for the purpose of dumping.

Congress has made it clear that its purpose in enacting the MPRSA and amendments was to prohibit the dumping of waste materials in the oceans, absent the necessary permit. In fact, such a prohibition is mandated by U.S. treaty obligations pursuant to the Convention. However, the drafters chose to sidestep the potential international ramifications of placing a blanket restriction on dumping in the high seas. Rather, Congress saw fit to invoke its power under the Commerce Clause (U.S. Const. Art. I, §8, Cl. 3) and address the problem of marine pollution by restricting the transportation of wastes for the purpose of dumping. Most likely, Congress never envisioned a situation where material could be dumped at sea without being transported for that purpose. Lumsdaine (1976), in discussing the coverage of the MPRSA, states that the Act should be broadly interpreted to include this apparent omission.

Broadly construing the requirement of the Act that the transporting be purposeful may remedy also this apparent omission. When they head to sea, fishermen know that gear will occasionally be lost or broken. If they intentionally dispose of broken nets and the like, it is conceivable that the purposefulness of the transporting may be inferred. In the absence of a statutory construction to cover the act of dumping rather than transportation for that purpose, the material purportedly responsible for numerous entanglements is not subject to regulation under the MPRSA.

Assuming that the MPRSA prohibition section is interpreted as being applicable only to the transportation of material for the purpose of dumping and not the act of dumping, the prohibitions of the Convention may have been elsewhere incorporated into the Act. Although the strictures of the Convention which prohibit the dumping of persistent synthetic materials at sea are absent from the prohibition section of the MPRSA, they have been incorporated into the dumping permit section. The statute (33 U.S.C. §1412(a)) reads:

> "The Administrator [of EPA] shall establish and apply criteria for reviewing and evaluating such permit applications.... To the extent that he may do so without relaxing the requirements of this subchapter, the Administrator, in establishing or revising such criteria, shall apply the standards and criteria binding upon the United States under the Convention, including its Annexes."

The EPA general counsel's office has interpreted the inclusion of the Convention criteria in this section as limiting them to permit review. Others have suggested that mention of the standards and criteria of the Convention has the effect of incorporating the totality of its provisions into the MPRSA. When viewed in the context of EPA's own regulations, the latter is probably the better interpretation.

The purpose and scope of EPA regulations which implement the MPRSA, as stated at 40 C.F.R. §220.1, include the establishment of "procedures and criteria for the issuance of permits by the EPA pursuant to section 102 of the Act." However, the same section of the regulations reiterates the prohibitions section of the Act, bringing them within the scope of the permit regulations. In discussing the relationship between the MPRSA and international agreements, the regulations (40 C.F.R. §220.1(b)) state:

> "In accordance with section 102(a) of the Act, the regulations and criteria included in this Subchapter...apply the standards and criteria binding upon the United States under the [Convention] to the extent that application of such standards and criteria do not relax the requirements of the Act."

Since the prohibitions of the MPRSA have been incorporated into the aforementioned subchapter, the standards of the Convention, including those regarding dumping without a permit, are probably applicable to the extent that they parallel or strengthen the Act. Section 108 of the MPRSA authorized the Administrator of EPA to issue such a regulation.[1]

If it is determined that the MPRSA is applicable to the discard of gear by domestic fishermen anywhere and foreign fishermen within the 12-nmi contiguous zone, any such discard would require a dumping permit. Among those substances for which permits will not be approved are "persistent inert synthetic or natural materials which may float or remain in suspension in the ocean in such a manner that they may interfere materially with fishing, navigation, or other legitimate uses of the ocean" (40 C.F.R. §227.5). So interpreted, these regulations, in line with the restrictions contained in Annex I of the Convention, would prohibit dumping of synthetic net fragments or similar material.

The MPRSA was enacted before the establishment of the United States' 200-mile EEZ. At the time of passage, the MPRSA prohibited dumping of material transported from outside the United States into waters then subject to U.S. jurisdiction, 12 miles from shore. In light of statements in the legislative history which express an intent to prohibit dumping within all coastal waters under U.S. jurisdiction, it seems consistent with the purposes of the MPRSA to extend its prohibitions and permit requirements to the bounds of the EEZ. An extension of MPRSA jurisdiction would have little effect on the activities of foreign fishermen, since they are already prohibited from discarding gear into the EEZ by the Magnuson Act, infra.

In summary, the MPRSA may be disparately interpreted. A blanket prohibition on the dumping of nondegradable fishing debris may be read into its prohibition section, particularly when viewed in light of statements in the legislative history. Even if the prohibition section is construed as applicable only to the transportation for the purpose of dumping, the prohibitions on dumping inert materials contained in the Convention may have been incorporated into the MPRSA via its permit section and the EPA regulations.

Federal Water Pollution Control Act (FWPCA) (33 U.S.C. §1251).--Section 311(b)(1) of the FWPCA (33 U.S.C. §1321(b)(1)) establishes the United States policy that

---

[1]Section 108 (33 U.S.C. §1418) provides that, "in carrying out the responsibilities and authority conferred by this subchapter, the Administrator [of EPA], the Secretary [of the Army], and the Secretary of the department in which the Coast Guard is operating are authorized to issue such regulations as they deem appropriate."

> "there should be no discharges of oil or hazardous substances into or upon the navigable waters of the United States, adjoining shorelines, or into or upon waters of the contiguous zone, or in connection with activities under the Outer Continental Shelf Lands Act or the Deepwater Port Act of 1974, or which may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States (including resources under the Fishery Conservation and Management Act of 1976)."

The definition of "discharge" given in section 311(a)(2) of the FWPCA (33 U.S.C. §1321(a)(2)) includes all dumping and other types of disposal that would apply to the act of discarding net fragments and other, related refuse. However, the definition of "hazardous substances" must be stretched if net fragments and other entangling debris are to be included within the coverage of this Act (33 U.S.C. §1321(b)(2)).

> "'Hazardous substances', which are designated by the Environmental Protection Agency, are those elements or compounds which, when discharged in any quantity...present an imminent and substantial danger to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, shorelines and beaches."

If the entanglement problem is of the suspected magnitude, there is little question that the disposal of netting and plastics presents an imminent and substantial danger to fish and wildlife. What is problematical in applying the FWPCA to the entanglement situation is whether the debris in question can be classified as either an element or a compound. The List of Hazardous Substances found at 40 C.F.R. Table 116.4A and prepared pursuant to Section 311 of the FWPCA, enumerates over 300 substances. All of these substances are toxic chemicals. Although it is conceivable that a creative interpretation of the hazardous substances definition could be used to include netting and debris, the toxicity of the chemicals currently designated as being hazardous evidences a narrower interpretation of this phrase by the EPA, the agency responsible for the enforcement of the Act.

Resources Conservation and Recovery Act of 1976 (RCRA) (42 U.S.C. §6901).--The RCRA regulates the disposal of solid wastes to promote the protection of health and the environment. Solid wastes controlled by this statute include discarded solid or liquid material from industrial, commercial, mining, and agricultural operations. Discarded fishing gear probably is a solid waste under RCRA since it is generated in the course of commercial activities.

Some solid wastes are further classified as "hazardous wastes" if they "pose a substantial present or potential hazard to human health or the environment where improperly treated, stored, transported, or disposed of..." because of their "quantity, concentration, or physical, chemical, or infectious characteristics" (42 U.S.C. §6903(5)). The EPA is required to promulgate a list of hazardous wastes taking into account the substances' toxicity, persistence, and degradability in nature, potential for accumulation in tissue, and other related factors such as flammability, corrosiveness, and other hazardous characteristics" (42 U.S.C. §6921). A list of designated hazardous wastes appears at 50 C.F.R. §261.30 et seq. Similar

to the FWPCA list of hazardous substances, this list is dominated by toxic chemicals. Other hazardous wastes may be designated under 50 C.F.R. §261.20 et seq. if they exhibit ignitability, corrosivity, reactivity, or toxicity. Net fragments exhibit none of these characteristics. Similar to most other pollution control statutes, the existing regulatory scheme is primarily designed to control toxic and reactive chemicals, not inert substances such as lost or discarded fishing gear or other debris.

Changes in the EPA regulations may be appropriate to accommodate the listing of net fragments and other synthetic materials. Under RCRA these materials may fit the definition of a hazardous waste because of their quantity, concentration and physical properties. Although no materials have been designated by EPA as hazardous wastes based upon their persistence or slow rate of degradation, these are considerations expressly enumerated in the Act.

Designation of some fishing gear as hazardous substances may be helpful in curtailing entanglements. Generators of hazardous wastes must keep accurate records which identify the quantities of hazardous waste generated and the disposition of those wastes. However, other requirements under RCRA for handling hazardous wastes may prove to be overly burdensome and inappropriate to the control of fishing debris. Records must be kept of all hazardous wastes transported, including their sources and delivery points. Facilities which store, treat, or dispose of hazardous wastes must be licensed and keep records of the dispositions of those wastes.

Whether fishing debris is characterized as hazardous waste or not, some potential benefits of RCRA may apply to the entanglement situation. The Act (42 U.S.C. §6973(a)) provides that:

> "Upon receipt of evidence that the handling, storage, treatment, transportation or disposal of any solid waste or hazardous waste may present an imminent and substantial endangerment to health or the environment, the Administrator [of EPA] may bring suit on behalf of the United States...to immediately restrain any person contributing to such [activities]...."

Fines may be levied upon violators who fail to comply with these restraints. Since net fragments and other fishing debris are solid wastes (and potentially hazardous wastes) and their disposal would likely result in the endangerment of the environment, injunctive relief may be applicable to the discard of these materials. To seek an injunction, however, the prospective violator must be identifiable.

Wildlife Laws

Wildlife statutes prohibit the taking of designated species absent a permit. A "take" is variously defined in the statutes, but always includes the killing of the protected animal. Takes can also be caused indirectly, through habitat destruction (Palila v. Hawaii Department of Land and Natural Resources, 639 F.2d 495 (9th Cir. 1981)). It is unlikely that takings by entanglements in gear that has been intentionally discarded would ever be authorized in a permit issued by a wildlife agency since such a take would be avoidable in most instances.

In general, no violation of these laws occurs until an animal is in fact taken. The mere discard of debris does not, except in extreme circumstances, constitute a violation of wildlife law. Without some mechanism for identifying the owners of gear responsible for entanglement, enforcement of these provisions is virtually impossible.

If it can be shown with reasonable certainty that an action is likely to result in a take, that action can be prohibited irrespective of whether it actually results in a taking. Under this interpretation, the Fish and Wildlife Service has prohibited waterborne activities in designated manatee protection areas (50 C.F.R. §17.100). Similarly, the discarding of marine debris could be regulated under wildlife statutes if areas can be identified in which the discard is reasonably certain to take protected species.

Marine Mammal Protection Act (MMPA) (16 U.S.C. §1361).--Section 102 of the MMPA, 16 U.S.C. §1372, sets out prohibitions on the taking of marine mammals. It is generally unlawful for any person or vessel subject to the jurisdiction of the United States to take any marine mammal on the high seas or within areas subject to the jurisdiction of the United States. Included in the definition of a "take" is the capture or killing of marine mammals. Permits for the taking of marine mammals may be issued under a variety of circumstances, including those takings which are incidental to commercial fishing operations. Disposal of netting or other gear at sea, however, is not integral to commercial fishing, and it is highly unlikely that an incidental taking permit would ever be issued which would encompass such conduct.

Incidental taking permits may not be issued under any circumstances for species which have been designated as depleted. Among marine mammals designated as being depleted are those species listed as endangered or threatened under the ESA. Since the Hawaiian monk seal and several species of great whales which inhabit North Pacific waters have been listed as endangered under the ESA, the narrower bases for issuing permits for depleted marine mammals is particularly germane to this discussion.

The North Pacific fur seal is currently excluded from management under the MMPA when the substantive terms of the MMPA contravene the Interim Convention for the Conservation of the North Pacific Fur Seal, 8 U.S.T. §2283, or the Fur Seal Act (International Fund for Animal Welfare v. Baldrige, No. 84-1838 (D.D.C. 28 June 1984)). However, should the parties to the fur seal convention let that agreement lapse, it is probable that management of the fur seal would come under the aegis of the MMPA.

A petition to list the fur seal as a threatened species under the ESA is now under consideration. If management were pursuant to the MMPA and the fur seal were listed under the ESA, the greater protection given a depleted species under the MMPA would apply. Takings would only be allowed for scientific research, and no incidental taking would be permissible.

The extent of whale entanglement is unknown, but that it is possible has been demonstrated in the North Atlantic. Thirty-five humpback whales became entangled in nets of the capelin fishery in the Labrador Sea during 1982. Of these, all but four were released alive (International Wildlife 1984).

Fur Seal Act (16 U.S.C. §1151).--The Fur Seal Act makes it unlawful for any person or vessel subject to the jurisdiction of the United States to engage in the taking of fur seals in the North Pacific Ocean except as provided for in the act or its regulations. The primary exceptions to the taking prohibition is the controlled commercial harvest conducted pursuant to the Fur Seal Treaty and the provision for subsistence taking by Indians, Aleuts, and Eskimos. Any capture or killing of a North Pacific fur seal by entanglement in fishing gear or other debris is likely to be a violation of the Fur Seal Act.

Endangered Species Act (ESA) (16 U.S.C. §1531).--Under the ESA it is generally unlawful for any person subject to the jurisdiction of the United States to take any endangered species within the territorial sea of the United States or on the high seas. A similar prohibition on the taking of threatened species is contained in 50 C.F.R. §227.71. More extensive than its definition under the MMPA, the term "take," when used in the context of the ESA, includes killing, trapping, harming, or capturing.

Under certain circumstances it is permissible to take endangered or threatened wildlife. The 1982 amendments to the ESA incorporated procedures whereby the incidental take of endangered species may be allowed (16 U.S.C. §1539(a)(1)(B)). It is possible that an incidental take permit could be issued to cover entanglement in accidentally lost fishing gear. However, this exception is probably not applicable to entanglement in debris that has been intentionally disposed of since an allowable taking must be incidental to an otherwise lawful activity. If disposal of nets at sea is considered to be a violation of one or more of the aforementioned pollution control laws, a permit could not be issued.

Two further limitations on the use of ESA incidental taking permits should be noted. As currently written, the ESA provides for the issuance of such permits only for takes which occur within a state or the territorial sea of the United States. (These permits may be issued only for takes which are otherwise prohibited by 16 U.S.C. §1538(a)(1)(B).) Permits which allow for incidental takes by entanglement or other means could not be issued for takes which occur beyond the territorial sea. Second, permits could not be issued for the incidental take of endangered or threatened marine mammals. Under 16 U.S.C. §1543 any more restrictive, conflicting provision of the MMPA takes precedence over the ESA. Since all listed marine mammals are deemed to be depleted under the MMPA, only permits for scientific research may be issued for those species.

Similar to incidental take permits, the incidental taking of threatened species pursuant to 50 C.F.R. §117.72(e) is probably inapplicable to entanglements resulting from discarded gear. Incidental taking of threatened species is allowable only during fishing or scientific research activities. The prohibited disposal of gear cannot rightly be considered a fishing activity.

As previously mentioned, some whale species and the Hawaiian monk seal, all of which are endangered, may be susceptible to entanglement. Although primarily tropical, some species of endangered or threatened sea turtles may also be subject to entanglement. Not presently on the endangered and threatened species list, the North Pacific fur seal is under consideration for listing as a threatened species.

Migratory Bird Treaty Act (MBTA) (16 U.S.C. §701).--The United States has entered into four separate treaties (with Canada, Mexico, Japan, and the U.S.S.R.) to protect migratory bird species.[2] The MBTA provides the domestic framework for satisfying the international obligations of the United States derived from these treaties. Among the protections afforded by the MBTA is a prohibition on the unpermitted capture or killing of migratory birds.

In applying the MBTA to the case of an unintentional poisoning of American widgeons, the court in United States v. Corbin Farm Service (444 F. Supp. 510, 529 (D. Calif. 1978)), held that "it is clear that Congress intended to make the unlawful killing of even one bird an offense." The court determined that no showing of intent was required to obtain a conviction for the killings: "the guilty act alone [was] sufficient to make out the crime" (Id. at 536). Even though the accused committed no willful violation, they were "in a position to prevent [the killings] with no more care than society might reasonably expect and no more exertion than it might reasonably exact from one who assumed his responsibilities" (Id. at 535-536, citing Morissette v. United States, 342 U.S. 246, 256). The court also noted that "penalties commonly are relatively small, and conviction does no grave damage to an offender's reputation" (Id. at 536).

Parallel to the situation in Corbin Farm, entanglement of migratory birds should be actionable without a showing of intent. The potential penalties in the two instances are identical and to refrain from the discard of fishing gear is in no way an onerous or unreasonable burden.

The list of migratory birds enumerated at 50 C.F.R. §10.13 includes several species that may be subject to entanglement. Examples of susceptible species are: several duck species, most shorebirds, grebes, gulls, jaegers, cormorants, murres, pelicans, and terns.

Ostensibly applicable to the problem of seabird entanglement, the MBTA may be limited in scope. A 1980 Department of Interior solicitor's opinion concludes that the taking prohibitions of the MBTA do not apply to U.S. citizens in foreign countries. A subsequent solicitor's opinion addresses the extraterritorial applicability of the MBTA in the fishing context.

> "[E]ven if the incidental take of migratory birds by...Japanese fishermen constituted a violation of the Japanese Treaty and the MBTA, prosecutions by the United States could be brought only if the violations occurred in the U.S. territorial waters."

---

[2]Convention for the Protection of Migratory Birds, 16 August 1916, United States-Canada, 39 Statute 1702; Convention for the Protection of Migratory Birds and Game Mammals, 7 February 1936, United States-Mexico, 50 Statute 1311; Convention for the Protection of Migratory Birds and Birds in Danger of Extinction, and Their Environment, with Annex, 14 March 1972, United States-Japan, 25 U.S.T. 3329; Convention Concerning the Conservation of Migratory Birds and Their Environment, 19 November 1976, United States-U.S.S.R., 29 U.S.T. 4647.

In the solicitor's view, the MBTA prohibitions apply to foreigners only within the U.S. 3-mile limit. If this is the case, prosecutions under the MBTA would not be suitable mechanism for preventing the majority of bird entanglements by foreign fishermen.[3]

In light of United States v. Mitchell (553 F. 2d 996 (5th Cir. 1977)), it is nearly certain that the MBTA taking sanctions are inapplicable within foreign jurisdictions. Applicability of the MBTA to takings by U.S. citizens on the high seas, however, is more likely. To limit the statute's applicability to U.S. territory would leave open a large immunity for violations by U.S. citizens on the high seas. Therefore, the MBTA may be useful in deterring some entanglements caused by domestic fishermen.

Fisheries Law

Fishery Conservation and Management Act (Magnuson Act) (16 U.S.C. §1801).--Primary among the purposes of the Magnuson Act is the conservation and management of the fishery resources found off the coasts of the United States. As one means of fulfilling that purpose, Congress has restricted foreign fishing within the 200-mile EEZ. Foreign fishermen are required to obtain permits before fishing in the EEZ. Permits issued under the Magnuson Act may contain appropriate conditions or restrictions which are related to fishery conservation and management. One restriction placed upon foreign fishing, codified at 50 C.F.R. §611.16, directly addresses the disposal of fishing gear:

> "Except in cases of emergency...or as specifically authorized...no fishing vessel may intentionally place into the fishery conservation zone [200-mile limit] any article, including abandoned fishing gear, which may:
>
> "(1) Interfere with fishing or obstruct fishing gear or vessels; or
>
> "(2) Cause damage to any fishery resource or marine mammal."

Furthermore, vessels which encounter any abandoned article are required to report the nature and location of the article immediately to the Coast Guard.

Although the foreign fishing regulations specifically prohibit the intentional disposal of gear, no counterpart regulations exist for domestic fishermen. The Magnuson Act provides for the development of fishery management plans (FMP's) which affect foreign and domestic fishing. All FMP's shall contain conservation and management measures which are appropriate to the fishery being regulated. It is not clear whether conservation and

---

[3]A contrasting view was expressed in a 1975 solicitor's opinion dealing with the applicability of the 1972 Migratory Bird Treaty with Japan to gill net fishing operations. Citing a section of the treaty which obligates the parties to prevent damage to birds from pollution of the seas, the opinion concludes that this focus "would appear to negate any intent to ignore activities on the high seas."

management measures may be included in an FMP if their purpose is solely to provide protection to marine mammals or birds. However, entanglements of wildlife are only one aspect of the problem created by the disposal at sea of fishing gear. There is little doubt that the dumping of gear and debris may be regulated under the Magnuson Act if the prohibition is directed towards alleviating the problems of ghost fishing or vessel entanglement.

Currently, a proposal to amend all existing FMP's to prohibit the disposal of gear at sea by domestic and foreign fishermen is under consideration by the National Marine Fisheries Service.

Pollution Abatement

Fishing gear and other debris which are currently adrift in the oceans may continue indefinitely to present a hazard to fish, wildlife, and navigation owing to their inert nature. Two statutes administered by the EPA could make funds available for the clean up of debris if the problem were shown to be severe enough. Similar to other statutes which control pollutants, these laws principally are tailored to the recovery of hazardous substances, particularly toxic wastes. However, a literal reading of the statutes indicates that the clean up of discarded fishing gear or other debris may be funded under these acts.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. §9601).--Pursuant to CERCLA (42 U.S.C. §9604(a)) authority is given for the clean up of certain hazardous waste sites:

> "Whenever (A) any hazardous substance is released or there is a substantial threat of such a release into the environment, or (B) there is a release or substantial threat of a release into the environment of any pollutant or contaminant which may present an imminent and substantial danger to the public health or welfare, the President is authorized to act, consistent with the national contingency plan, to remove...such hazardous substance, pollutant, or contaminant...."

Clean up of these sites may be accomplished using monies of the CERCLA trust fund, in some instances, even when the violator is not identifiable.

A "hazardous substance" for the purposes of CERCLA includes any hazardous waste identified under RCRA, those hazardous substances listed under the FWPCA, or any other substance designated pursuant to CERCLA. As discussed previously, it is conceivable that net fragments may fit the criteria for designation as hazardous under RCRA or the FWPCA, although they are not currently listed. Under CERCLA, EPA may designate as hazardous those substances which, "when released into the environment may present substantial danger to the public health or welfare or the environment..." (42 U.S.C. §9602(a)). What constitutes the public welfare is not delineated under CERCLA. Guidance regarding the meaning of this phrase may be gleaned from the FWPCA. In that act, the "public health or welfare of the United States" includes, but is not limited to, "fish, shellfish, and wildlife and the shorelines and beaches..." (33 U.S.C. §1321(d)). If this standard is applicable to CERCLA, it is clear that the public welfare would be imperiled by entanglement of fish or wildlife, and that EPA could designate net fragments as a hazardous substance.

If discarded fishing gear were to be designated as hazardous, the fact that it had been released into the environment would allow the President to provide remedial actions. For the purposes of CERCLA, "environment" includes the territorial seas, the contiguous zone, and the 200-mile EEZ.

"Pollutant or contaminant" is defined in 42 U.S.C. §9604(b). The phrase includes, but is not limited to any "substance...., which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavior abnormalities, cancer...or physical deformations, in such organisms...." Although fishing debris may cause the death of organisms, it is not the result of ingestion, inhalation, assimilation, or mere exposure. However, the definition of pollutant or contaminant is not necessarily limited to substances which are harmful to organisms in one of these four ways. The EPA could, if it thought the situation severe enough, probably designate net fragments and other debris as pollutants or contaminants. If the debris were determined to be a pollutant or contaminant, the disposal must present an imminent or substantial danger to the public health or welfare. Assuming that the FWPCA definition of public welfare is applicable to CERCLA, such a danger is probably engendered by fishing debris.

The final requirement under CERCLA which limits the authority to clean up hazardous substances, pollutants, or contaminants is that the actions must be consistent with the national contingency plan (NCP). The NCP sets up a system whereby priorities for taking remedial actions for releases are set. Among the criteria to be considered in ranking releases based upon the relative risk or danger to public health or welfare of the environment are: the population at risk, the hazard potential of the substances, the potential for contamination of drinking water supplies, the potential for the destruction of sensitive ecosystems, and other appropriate factors (42 U.S.C. §9605). A detailed description of the hazardous waste site ranking system appears at 40 C.F.R. part 300, Appendix A. At present, 538 sites have been listed and ranked.

For the clean up of discarded fishing gear to be effectuated using the funds available under CERCLA, it must be shown that the scope of the entanglement problem is extensive enough to warrant a priority ranking. To accomplish this, the identification of a site where the problem is particularly acute is probably necessary. It is unlikely that any single release would be significant in itself. To be a problem worthy of CERCLA clean up attention, an area of limited size where debris is particularly concentrated or harmful to the environment would probably have to be identified. It should be noted, however, that CERCLA (42 U.S.C. §9604(d)(4)) provides that:

> "Where two or more noncontiguous facilities are reasonably related on the basis of geography, or on the basis of the threat, or potential threat to the public health or welfare or the environment, the President may, in his discretion, treat these related facilities as one for the purposes of this section."

Although clean up may be effectuated without determining the generator of the wastes, a system for identifying the sources of discarded gear may prove helpful in the context of CERCLA. If the polluters were known, funding for the clean up could be recovered from them. In that event, adherence to the priority system for hazardous waste sites would be less strict. Additionally, CERCLA allows for the assessment of damages against the generator for injury to, destruction of, or loss of natural resources resulting from the release of a hazardous substance.

Federal Water Pollution Control Act (FWPCA) (33 U.S.C. §1251).--In addition to possible clean up under CERCLA, clean up is also possible under the FWPCA if net fragments are determined to be hazardous substances for its purposes. If a substance is discharged upon the waters of the United States, including those of the EEZ, "the President is authorized to act to remove or arrange for [its] removal...unless he determines such removal will be done properly by the owner or operator of the vessel..." (33 U.S.C. §1321(c)(1)). Since most often the owner or operator of the vessel is unknown, the Government could undertake the clean up of fishing debris.

Enforcement Considerations

Existing Legislation

Typically, pollution and wildlife laws are ineffectual with regard to entanglements. Even though thousands of illegal takes may occur annually, it is virtually impossible to identify the offenders. Net fragments may remain suspended in ocean waters indefinitely, entangling fish and wildlife for years, allowing violations to be far removed temporally and spatially from the take.

Pollution control laws are likewise generally unenforceable. Assuming that the disposal of net fragments is a violation of these laws, the incidents take place in distant and diverse areas at sea and mostly out of the view of observers. Even if the origin of a net fragment is determined, it would still be difficult to prove that it was dumped and not merely lost in the course of fishing activities. A similar problem exists in enforcing the regulations issued under the Magnuson Act. To be a violation, gear must have been intentionally discarded.

A further impediment to markedly reducing entanglements is worthy of note. The statutes considered herein, even if functioning at peak efficiency, are applicable only to those persons and vessels subject to United States jurisdiction. There is no unilateral action that the United States can take which would address the disposal of gear by foreigners outside the 200-mile limit.

Alternative Enforcement Mechanisms

Without a workable enforcement scheme, existing mechanisms for controlling the disposal of gear or entanglements are mere paper tigers. Four alternative enforcement schemes are presented below.

Gear marking.--It has been suggested that a more extensive marking of fishing gear be required. In this way violators will be much more readily

identifiable. The cost involved in such a program may be prohibitive, though, since markings would have to be detailed enough to distinguish a large number of fishermen and numerous enough to allow identification of small net fragments.

Another consideration to be weighed before instituting a marking system, is what type of activity is the regulation seeking to preclude. Although it is true that all lost gear is equally liable to ensnare fish or wildlife, is it reasonable to punish those who accidentally lose or break equipment? If the purpose behind a marking system is to prosecute those who intentionally dispose of gear, a showing of that intention is required in addition to merely identifying the origin of the gear. Marking alone will not provide such a showing. If marking is to be used to identify all persons unlucky enough to have entangled a protected animal in lost gear, close scrutiny should be given to the reasonableness of requiring fishermen to recover any portion of accidentally lost gear.

Bounty system.--Another proposed mechanism to alleviate the entanglement problem is the institution of a bounty system for lost, abandoned, or discarded fishing gear. Theoretically, fishermen would be paid for turning in pieces of nets that they may otherwise discard at sea. A bounty, however would only be effective against entanglement in gear that is intentionally discarded or recoverable when lost. It is not known what percentage of entanglements occur in these categories of fragments.

Economic factors must be well evaluated in designing a bounty system. The reward for turning in used nets would have to be high enough to provide an incentive for turning in gear that would otherwise be discarded at sea, but low enough to make the program affordable. Checks would also have to be designed which would foil those who may seek a reward for turning in old, retired nets that may already have been disposed of properly. Reports indicate that trawlers often recover fragments in their nets. A bounty system may be useful in encouraging these fishermen to bring in this debris rather than rereleasing it into the ocean waters.

There exists a persistent rumor that Korea has implemented a bounty system on nets. When asked about this, a Korean fisheries official was unaware of the existence of any such system. If a Korean bounty program does exist it may be helpful as a model for the design of a United States system.

Expanded observer network.--At present, observers are only placed on foreign fishing vessels. Even though the Magnuson Act prohibits the discard of gear by foreign fishermen, some violations probably occur. Stricter enforcement of existing regulations may alleviate some entanglements. The observer network could also be expanded to include domestic fishing vessels. Although the authority for placing observers on domestic vessels is uncertain, the decision in Balelo v. Baldrige 724 F. 2d 753 (9th Cir. 1984) would seem to permit it.

Citizen suits and rewards.--Enforcement of most of the statutes that may be applicable to the entanglement situations is difficult at best. Those responsible for enforcement often cannot cover the expansive area over which violations might occur. In some instances agencies utilize

these limited resources to counter more immediate threats to human health and welfare. Two ways of increasing the enforcement effort regarding these laws are by allowing citizens to commence legal actions or by providing an incentive to those who provide information that is used in enforcement actions.

Citizen suits are provided for by the MPRSA (33 U.S.C. §1415(g)). Under that section, attorney's fees may be awarded in appropriate cases. One such case where a citizen plaintiff prevailed and was awarded fees is Save One Sound Fisheries v. Calloway (429 F. supp. 1136 (D.R.I. 1977)). The court there states, "[t]he possibility of such fees serves as an incentive for private parties to enforce provisions of the various statutes deemed too important to be left to the limited enforcement resources of the Justice Department" (Id. at 1139). Citizen enforcement is generally difficult, however, in view of the problems in gathering evidence and successfully prosecuting this type of lawsuit.

Providing rewards to those who furnish information which leads to successful prosecutions is another way of obtaining public participation in enforcement. The U.S. House of Representatives version of the MPRSA provided that a portion of a levied fine would be paid to any individual who provided information leading to the conviction. The Senate apparently did not approve of the notion of federally subsidized informants and did not adopt the provision (Weinstein-Bacal 1978).

It should be noted that the effectiveness of rewards for information is doubtful. The ESA allows for such rewards but that provision is seldom, if ever, invoked.

LITERATURE CITED

Fowler, C. W.
1982. Entanglement as an explanation for the decline in northern fur seals of the Pribilof Islands. Unpubl. manuscr., Natl. Mar. Mammal Lab., Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, Seattle, WA 98115. (Background paper submitted to the 25th Annual Meeting of the Standing Scientific Committee of the North Pacific Fur Seal Commission, Ottawa, Ontario, Canada, 1982.)

Lumsdaine, J. A.
1976. Ocean dumping regulation: An overview. 5 Eco. L. Q. 753.

Weinstein-Bacal, S.
1978. The ocean dumping dilemma. 10 Law Am. 868.